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The effect of aerobic exercises on visual reaction time (VRT) in overweight adolescents

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Abstract

Background: Overweight is shown to have a detrimental effect on reaction times. Besides this, pathophysiological changes like systemic inflammation, insulin irregularity etc. linked with obesity are seen as reasons for prolonged visual reaction time (VRT). Impaired VRT in the early ages of life can have deleterious effects. Aerobic exercise promotes executive function, weight loss, enhanced muscular coordination, and task performance speed and accuracy, all of which could aid in improving VRT in adolescents.

Method: The experimental study was conducted with 48 overweight adolescents (age: 10-18yrs). The participants with Visual Reaction Time (VRT)>200ms and BMI≥23 percentile to 27 percentile (equivalent of adult BMI) were recruited for the study. The readings for Visual Reaction Time (VRT) were recorded using a Digital Reaction Time Instrument at baseline and after 6 weeks of aerobic dance intervention.

Results: The normality of the data was analyzed for VRT of all colors. Owing to that the pre- post comparison was done using non parametric test like Wilcoxon test & parametric test like paired t-test respectively. The results showed significant improvement in VRT post-intervention of all the colors ($p<0.0001$).

Conclusion: The study results concluded that overweight adolescents can have increased visual reaction time due to obesity. The Aerobics intervention helps to improve visual reaction time and it will make their daily life stronger and faster.

Keywords: Adolescents, visual reaction time, VRT, aerobics, BMI

Introduction

Visual Reaction Time (VRT) is the length of time that is required by a human to discern a visual stimulus and retaliate to it ^[1]. VRT is important for us to determine because almost every activity of our daily living requires different stimuli to be perceived visually and acted so. Out of many factors BMI is believed to influence the VRT as the changes associated with overweight like systemic inflammation, insulin irregularity, impaired inhibition capacity etc. influences the reaction time ^[2, 3]. Rates of overweight is rapidly growing in youngsters, this has put adolescents at higher risk of delayed reaction times. As increased rates of obesity are linked to physical inactivity and exercising help improve BMI; it might help shorten the VRT ^[4]. Hence, we aim to find out the effect of aerobic exercises on VRT in overweight adolescents.

Materials and Methods

The experimental study was conducted with an online protocol of intervention. The study was registered with CTRI (CTRI/2021/09/036752) before starting the trial. The institutional ethical clearance was taken regarding the continuation of the study. The permission from the Physiology department of Dr. DY Patil Medical College and Research Centre was taken to use the Digital Reaction Time Instrument for recording reaction time.

After taking required permissions, the screening was done for study from different residential areas and educational institutes of PCMC for the participants. The allocation was done using convenience sampling method. Prior to inclusion, the subjects were informed about the study and a written assent /consent was taken from the subjects/parents of the subjects. The participants were screened for BMI and Visual reaction time (VRT); the participants with BMI≥23 percentile to 27 percentile (equivalent of adult BMI) and VRT>200ms were included in the study.

The BMI was calculated using IAP Growth Charts [5]. The participants with any systemic illness, orthopedic, psychological and neurological deficits were excluded from the study. The screening of 100 subjects was done and 48 candidates were selected on the basis of inclusion criteria.

The process for performing the VRT task was explained to all the participants with videos and allowing for demonstration and practice prior to taking readings to make participants confident about the task to be done. The participants were allowed to sit comfortably in a chair and then asked to respond by clicking on the button to stop the blinking of the light. The readings were recorded on a display on the investigator side using Digital Reaction time measuring instrument available at Department of Physiology, Dr. DY Patil College of Medical College, Pune. This instrument has range of 1s to 1/10th ms with accuracy of $\pm 1/10^{\text{th}}$ ms; therefore it was used as a reliable source for measuring the outcome [6]. In the task, there was blinking of a particular light color either red, blue, green or yellow depending upon the choice of instructor; the participant had to respond to stimulus to stop the blinking. The digital recording of time interval between initiation of stimulus till the end was done by Digital reaction time instrument (showing time in ms). Total of 3 readings were taken for each trial, mean of all the readings were considered as final reading for that particular color. After collecting the baseline data for values of VRT in overweight adolescents, the participants were supervised for 6 weeks of aerobic online exercise sessions. The online group sessions for aerobics were conducted on online platform of Zoom Meetings. The Aerobic exercises include- Aerobic dance performed for 6 weeks; 5 days a week for total 40 mins including 5 mins time for warm-up and 5 mins time for cool-down. Warm-up exercises included were: Light spot jogging, Arm swings, fast-paced side stepping while Cool-down exercises were: General stretching with 10-15 secs hold. Aerobic dance was divided and structured into week-wise phases with progression to the more complicated steps as: Basic right and left, V step, A step (Week 1 & 2), Tap up, Turn step, T step (Week 3 & 4), Across the top, Charleston (Week 5 & 6). After the completion of 6 weeks of intervention the readings of VRT were taken again as post-intervention readings.

Results

For the experiment, sample size was calculated using the software and it came out to be 48 samples with 10% exclusion rate, considering 5% significance rate. In this study, 100 overweight adolescents were screened for Visual reaction time. Out of which, 48 were included and completed the study. The Visual reaction time was recorded at baseline and at 6th week post-intervention for all the participants. The mean of three readings of Visual reaction time for all different colors viz. red, yellow, blue and green were used for statistical analysis as a quantitative measure. The normal distribution was rejected for VRT of red, blue and yellow colors except green color. The data was analyzed using paired t-test for green color and Wilcoxon signed rank test for red, yellow and blue colors.

All the statistical analyses were done keeping 95% CI and 5% significance rate. The total no. of 26 boys and 22 girls were recruited in the study. The total no of overweight adolescents who underwent the study protocol was n=48. The mean age and BMI characteristics of the overweight adolescents were 16.56 ± 3.48 years and 23.42 ± 2.19 percentile respectively.

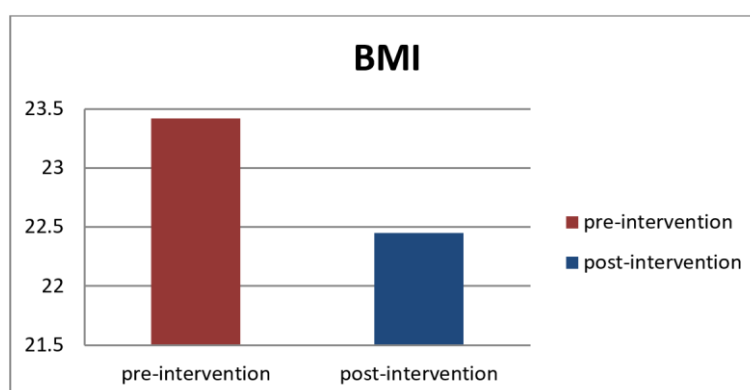
The mean values of Visual reaction time (VRT) for different colors were Red (476.34ms), blue (444.7), yellow (475.9) and Green (479.9) in overweight adolescents. The comparison of pre-intervention and post-intervention readings of VRT for all colors showed mean improvement of 68.50 ms in red, 66.06 ms in yellow, 46.21 ms in blue, 78.86 ms in green colors with $p < 0.0001$ (Table 1). This shows that there was significant improvement in VRT post-intervention of all the colors. There was more improvement in VRT of green color with effect size of 0.75 with least improvement in VRT of blue color with effect size of 0.44.

The comparison of mean of BMI of 48 overweight adolescents showed no statistical improvement ($p = 0.448$). But there was found a clinical improvement in BMI with mean difference of 0.97 (Graph 1).

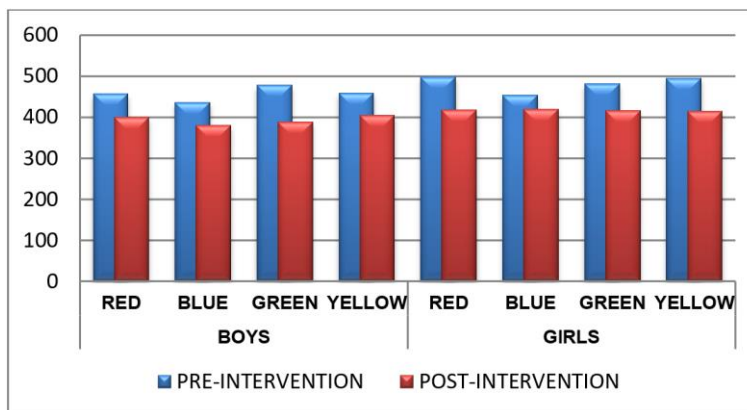
The gender-wise comparison of means of VRT of all colors in girls and boys showed that there is no significant difference in improvement of VRT in both genders; but girls showed better clinical improvement than boys (Graph 2).

Table 1: Comparison of Means of VRT readings for different colors

Variable	Mean \pm SD (Pre-intervention)	Mean \pm SD (Post-intervention)	Mean difference	Z- value/ t- value	p-value
Red	476.34 \pm 102.7	407.8 \pm 89.46	68.50	5.65	$p < 0.0001$
Yellow	475.9 \pm 97.61	409.9 \pm 84.65	66.06	5.91	$p < 0.0001$
Blue	444.7 \pm 87.88	398.4 \pm 85.65	46.21	5.53	$p < 0.0001$
Green	479.9 \pm 87.75	401.07 \pm 80.37	78.86	12.05	$p < 0.0001$



Graph 1: BMI readings pre- and post-intervention



Graph 2: Gender-wise comparison of pre-intervention and post-intervention VRT for all colors

Discussion

This study was undertaken to see the effect of aerobic exercises on Visual Reaction Time in overweight adolescents. We found that there is significant improvement in Visual reaction time of all colors with maximum improvement in VRT of green color in overweight adolescents. We observed that the values of VRT in overweight adolescents were in range of 444-479ms. These values are higher when compared to normal values for VRT of 180-200ms^[7]. These findings are supported by Asmita S Nene *et al.*, Deepmala Nagarao Deore *et al.* and Reena Kumari Jha *et al.* where they also found that VRT was prolonged in individuals with BMI of overweight and obese. Mohd. Faridz Ahmad and Muhammad Amir Asyraf Rosli studied the effects of aerobic dance on cardiovascular health and body weight among women; they concluded that 6 weeks of Aerobic Dance can help in significant weight reduction along with improvement in cardio-vascular health. In our study, we also found significant improvements in VRT with Aerobic Dance exercises in the span of 6 weeks but decrease in body weight was not statistically significant as contrary to their study^[8]. Our findings of the study are in consistent with the findings of study by Monika Garg *et al.* in which they observed that aerobic exercisers have better reaction times when compared to non-exercisers. As a result of aerobics, there is better attention and focus development which indirectly affects visual reaction time^[8, 9]. Other hypothesis is that to maintain the elevated levels of Heart rate and blood pressure due to exercise, body releases epinephrine that binds with beta-2 receptors of the vessels and results in dilatation of blood vessels which ultimately reduces the resistance of peripheral structures. This reduction of opposing force leads to improved blood supply to various parts of body; improved blood flow results in improved and better cognitive functioning of brain and hence can be concluded that brain can react better and in shorter times to the stimuli^[10].

We founded that there is no significant difference in VRT of girls and boys as a whole; after intervention girls have shown better improvement in their VRTs. This might be due to reason that pre-intervention values for VRT were already less and better for boys. Hence, our results are in agreement with the results of previous literatures that showed boys have better VRT for all colors than their female counterparts^[11, 12].

Our study concluded that there is significant improvement in Visual Reaction Time of all the colors with 6-weeks of aerobic training along with clinically significant improvement in weight status (BMI) of overweight

adolescents.

Conclusion

The study results concluded that the Visual reaction time is prolonged in overweight adolescents. The findings showed that the intervention of Aerobics proved useful in improving VRT of overweight adolescents.

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Conflicts of Interest: NIL

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